Docket: AM-5825

3600.5825
January 15, 2003 (11:54am)

REMARKS

Claims 1-11 and 14-17, 19, 20, and 22-28 remain in the application.

The Examiner has rejected Claims 1-8 under 35 U.S.C. §112, ¶2 for a number of problems with consistent nomenclature. The indicated amendments to Claims 1 and 5 should correct these problems without affecting the scope of the claims.

The Examiner has rejected Claims 1-11 and 14-21 under 35 U.S.C. §103(a) as being obvious over Applicants' admitted art in view of Maydan et al. (U.S. Patent 4,951,601, hereafter Maydan). The rejection of unamended base Claim 9 is traversed. Base Claims 1, 5, and 14 have been amended to require two vacuum isolated transfer chambers, one coupled to the etch chamber, the other coupled to the deposition chamber. The rejection of the amended claims is also traversed. It is believed that the amendment to Claim 9 does not affect its scope or patentability but simply serves to use consistent terminology between the claims.

Maydan allows that several different types of reactors may be connected to his vacuum transfer chamber, and at col. 12, ll. 23, 24 suggests mixing etch and deposition chambers. However, Maydan fails to suggest the advantages of connecting the etch chamber to a first transfer chamber and connecting the deposition chamber to a second transfer chamber vacuum isolated from the first one. Indeed, Maydan's language of mixing etch and deposition chambers suggests that they can be equivalently placed, not separated onto the different specifically recited transfer chambers as is now being claimed. Further, some of the claims including unamended base Claim 9 impose different requirements on the maximum pressures in the two transfer chambers. Maydan neither suggests two different base pressures nor suggests that the etch chambers be coupled to the high-pressure transfer chamber and the deposition reactor to the low-pressure transfer chamber.

The present inventors at the passage beginning at the bottom of page 12 of the filed application disclose the advantage of the transfer isolation in isolating fluorine from the metal. The fluorine etch process is now recited in newly added dependent claims. Maydan fails to

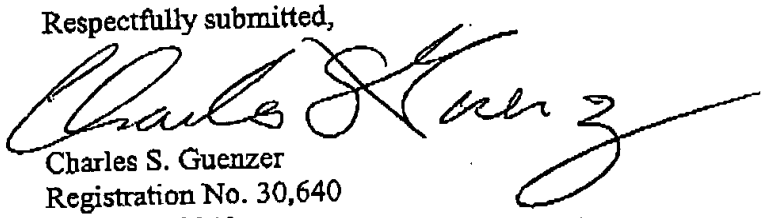
suggest either the fluorine contamination problem or its solution.

Further, base Claims 14 and 18 require that the passageway between the two transfer chambers be doubly gated (support at page 15, line 13). New dependent claims have also been added for the double gating. Such double gating provides much better isolation, for example, of fluorine between the chambers. Maydan fails to disclose such double gating between his multiple transfer chambers of FIG. 20, and he apparently intends his intermediate storage elevator 50A to have the same structure as the storage elevator 50 of FIG. 2, that is, no double gating as is being additionally claimed. Instead Maydan's single gate 38 of FIG. 2, when opened, directly communicates the two transfer chambers. That is, they are not vacuum isolated. Although the doubly gated Endura platform having a staged vacuum is admitted to be prior art, no prior art has been shown for placing an etch reactor on its high-pressure side.

In view of the above amendments and remarks, consideration and allowance of all claims are respectfully requested. If the Examiner believes that a telephone interview would be helpful, he is invited to contact the undersigned attorney at the listed telephone number, which is on California time.

Date: 15 Jan. 2003

Respectfully submitted,



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Version with markings to show changes made

In the claims:

1. (Twice Amended) An integrated etch and metal liner process of a substrate including a dielectric layer and covered with a patterned mask material, comprising the steps of:

transferring the substrate into a first transfer chamber held at a first pressure below atmospheric pressure;

transferring the substrate from the first transfer chamber to an etching chamber and etching according to said patterned mask material through said dielectric [oxide] layer to an [said] etch stop layer to form a hole in said oxide layer;

ashing said mask material;

removing said etch stop layer exposed at a bottom of said hole;

transferring the substrate from the first transfer chamber to a second transfer chamber through an intermediate load lock;

transferring said wafer from said second transfer chamber to a metallization chamber [through said transfer chamber and] without exposing the substrate to an atmospheric pressure;

depositing a barrier layer in said metallization chamber; and

depositing a seed layer.

5. (Three Times Amended) An integrated etch and metal liner process of a substrate including [a] an etch stop layer covered with a dielectric layer covered with a patterned mask material, comprising the steps of:

etching according to said mask through said dielectric [oxide] layer to said etch stop layer to form a hole in said dielectric [oxide] layer;

ashing said mask material;

removing said etch stop layer exposed at a bottom of said hole;

transferring said substrate to a first transfer chamber maintained at a sub-atmospheric

pressure;

transferring said substrate from said first transfer chamber to a second transfer chamber through an intermediate load lock, wherein said second transfer chamber is isolated form said first transfer chamber;

in a reactor coupled to said second transfer chamber, depositing a barrier layer; and

in a reactor coupled to said second transfer chamber, depositing a metal seed layer;

wherein said substrate is maintained between said etching, ashing and removing steps and during said transferring steps at sub-atmospheric pressures.

9. (Amended) An integrated etch and metal liner process of a substrate including a stop layer covered with an oxide layer covered with a patterned photoresist mask, comprising the steps of:

a first step of transferring said substrate into a first transfer chamber maintained at a pressure of no more than 1 Torr; [,]

a second step of transferring said substrate from said first transfer chamber to an oxide etch reactor; [:]

in said oxide etch reactor, etching said oxide layer according to said mask to form a hole in said oxide layer;

a third step of transferring said substrate from said oxide etch reactor through said first transfer chamber to a second transfer chamber isolated from and first transfer chamber and maintained at a pressure of no more than 10^{-6} Torr; and

a fourth step of transferring said substrate from said second transfer chamber to at least one reactor to deposit a layer in said hole.

14. (Amended) An integrated process performed in processing reactors connected to first and second [at least one] central vacuum transfer chambers [chamber] held at pressures of no more than 1 Torr, said first and second central vacuum transfer chambers being linked by a

doubly gated vacuum passageway, said processing reactors, [and] said first and second [at least one] central vacuum transfer [station] chambers, and said vacuum passageway being formed on a single platform, said process comprising the steps of:

loading into said first [at least one] central vacuum transfer chamber through a load lock a substrate having a dielectric layer covered by a patterned resist material;

in at least one etching reactor connected to said first [at least one] central vacuum transfer chamber through a respective slit valve, etching said dielectric layer in said substrate according to said patterned resist material to form a hole therethrough and thereafter ashing said resist material;

in at least one deposition reactor connected to said second [at least one] central vacuum transfer chamber through a respective slit valve, depositing a liner layer on sides of said hole;

wherein said substrate is not exposed to atmospheric pressure between said etching step and said depositing step.

Please cancel Claim 18.

19. (Amended) The process of Claim [18] 14, wherein said at least one etching reactor [reactors] includes an etch reactor for etching said dielectric layer and an ashing reactor for ashing said resist material and wherein said at least one deposition reactor includes a first sputter reactor for depositing at least a part of a barrier layer and a second sputter reactor for depositing a copper seed layer.

20. (Amended) The process of Claim [18] 14, wherein said second central vacuum transfer chamber is held at a pressure of no more than 10^{-6} Torr.

Please cancel Claim 21.

22. (New) The process of Claim 1, wherein said etching is performed using a fluorine-based chemistry.

23. (New) The process of Claim 1, wherein said intermediate loadlock is doubly gated.

24. (New) The process of Claim 5, wherein said etching step uses a fluorine-containing etching gas.

25. (New) The process of Claim 5, wherein said intermediate loadlock is doubly gated.

26. (New) The process of Claim 9, wherein said etching step uses a fluorine-containing etching gas.

27. (New) The process of Claim 9, wherein said first and second transfer chambers are isolated by a doubly gated load lock.

28. (New) The process of Claim 14, wherein said etching step uses a fluorine-containing etching gas.